UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

SEP 2 4 2013

REPLY TO THE ATTENTION OF:
WU-16J

CERTIFIED MAIL 7009 1680 0000 7674 5369
RETURN RECEIPT REQUESTED

Mr. Scott McDonald
Project Manager
Archer Daniels Midland Company
4666 Faries Parkway
Decatur, Illinois 62526

Subject: Request for Additional Information Regarding Archer Daniels Midland (ADM) Well CCS #2, United States Environmental Protection Agency Underground Injection Control (UIC) Permit Application #IL-115-6A-0001

Dear Mr. McDonald:

In order to complete our review of ADM's permit application, we need additional information described in the enclosures with this letter. The enclosures pertain to the following issues:

Enclosure 1: The five required project plans
Enclosure 2: ADM's request for the alternate post closure timeframe of 10 years
Enclosure 3: Endangered Species List determination
Enclosure 4: List of references missing from the original application.

Please submit this information not later than 30 days from the receipt of this letter.

Inquiries concerning the contents of the enclosure may be directed to Dana Rzeznik of my staff by telephone at (312) 353-6492 or by email to rzeznik.dana@epa.gov.

Sincerely yours,

Rebecca Harvey, Chief
Underground Injection Control Branch

cc: Mark Burau, ADM, with enclosures
Stephen Nightingale, IEPA

Enclosures

Review of Plans Information in Archer Daniels Midland's (ADM) Permit Application for CCS #2 and Request for Additional Information

The Class VI Rule requires (at 40 CFR [Code of Federal Regulations] 146.84(b); 146.90; 146.92(b); 146.93(a); and 146.94(a)) that Class VI owners or operators develop, submit, gain approval of, maintain and comply with a series of five project-specific plans[1] that largely govern the operation, testing and monitoring, Area of Review (AoR) evaluation and reevaluations, well plugging and post-injection site care approach for a Class VI well –as they are incorporated into the permit as permit conditions. Understanding that your permit application was the first to be submitted to EPA following promulgation of the final regulations in December 2010, we acknowledge that the development of such plans may have presented certain challenges.

In the interest of time and with a goal to facilitate the permitting process, we have made great strides in extracting the necessary and relevant information from the initial permit application (including your Injection Well Plugging Plan and Emergency and Remedial Response Plan), subsequent submittals (i.e., the revised AoR evaluation submitted in June 2012) and responses to Requests for Additional Information to put together the framework for all five plans.

This document summarizes additional information needed to more fully understand your proposed approach and complete the development and evaluation of the Geologic Sequestration (GS) project plans for ADM's CCS2 injection well. The requests and questions in this document will guide the development of plans that, when implemented, will meet all Class VI requirements, generate information needed to ensure Underground Sources of Drinking Water (USDW) protection, inform AoR reevaluations, and support a non-endangerment demonstration. Once we have received and incorporated the additional information you submit into the plan frameworks, we will submit them to you for your concurrence.[2]

AoR and Corrective Action Plan

To develop a complete AoR and Corrective Action Plan that complies with the Class VI Rule requirements at 40 CFR 146.84 and finalize the AoR evaluation for the administrative record, please submit the following:

- A revised map that depicts the final AoR (40 CFR 146.82(a)(3)(i)):
    - See Attachment 1 and clarify whether the shape file or the information in Figure 5-2 of the June 2012 AoR evaluation chapter is the correct AoR;
- An updated pressure front delineation using a method that accounts for the overpressured injection zone (40 CFR 146.84(b) and (c));
- Sensitivity analyses for residual aqueous and gas saturation (40 CFR 146.82(a)(21);
- A description of the quantitative and qualitative triggers for an unscheduled reevaluation of the AoR (40 CFR 146.84(b)(2)(ii));
- Identification of wells in the most current AoR that were evaluated for purposes of compliance with 40 CFR 146.84(c)(2) and (3).

[1] Area of Review and Corrective Action; Testing and Monitoring; Well Plugging; Post-Injection Site Care and Site Closure; Emergency and Remedial Response

[2] Acknowledging that they are technically required to be prepared by the permit applicant.

Testing and Monitoring Plan

Quality Assurance and Surveillance Plan

Please submit a quality assurance and surveillance plan for all required testing and monitoring pursuant to 146.90(k).

Analysis of the CO_2 Stream

Does ADM have any historical data from the CO_2 source facility to support its statement that the CO_2 is pure, the content tends not to vary and that the CO_2 stream analysis proposed to meet the requirements of 40 CFR 146.90(a) is appropriate?

> It would be beneficial to verify the constancy of the CO_2 stream to confirm that no additional analytical parameters are needed in the CO_2 stream analysis proposed to meet the requirements of 40 CFR 146.90(a). If such information does not exist at this time, a review could be done after injection has begun and if necessary the injectate monitoring plan may need to be revised to address changes.

Continuous Monitoring of Flow, Pressure, Temperature and Volume of Injected CO_2 and Monitoring of the Pressure in the Annulus between the Tubing and Casing

Can ADM provide any information on the specific types of instruments that will be used to perform continuous monitoring to meet the requirements of 40 CFR 146.90(b)?

> While it is not necessary to identify particular instrument models in the plans, evaluating the specifications for the instruments before construction would help to ensure proper instrument selection and to avoid the need for replacing instrumentation after installation if the specifications should prove unsatisfactory for the required monitoring.

How does ADM plan to calculate the volume of CO_2 injected?

On what basis did ADM select an annulus pressure change of more than 100 psi as the threshold for investigation?

> Typically in Region 5, a 3 percent annulus pressure change over a 60 minute test is used. Perhaps net changes in annulus pressure over a particular stretch of time might be more effective than an absolute psi pressure change. Another method would be net changes in a seal tank/surge tank that was connected to the annulus. This would allow for temperature based fluctuations into and out of the tank as long as it was showing no significant net gain or loss.

Ground Water Monitoring above the Confining Zone

Attachments 2 and 4 summarize EPA's understanding of where ADM proposes to perform ground water monitoring to meet the requirements at 40 CFR 146.90(d). Can ADM confirm that the information in these attached tables is accurate? If it is inaccurate, please provide the correct and current information on the proposed ground water monitoring approach.

How will ADM select the location of monitoring wells and how will monitoring at these locations provide sufficient information about any geochemical changes throughout the AoR?

GM (Geophysical Monitoring well) #2 terminates in the St. Peter and cannot be used to monitor conditions directly above the confining zone (i.e., in the Ironton-Galesville) near the injection well, where pressure conditions would be highest. Conversely, VW (Verification Well) #1, which will be approximately 2,800 feet away from the well, will be used to monitor the Ironton-Galesville but not the St. Peter. A more robust monitoring scheme would extend GM #2 so that it can monitor the Ironton-Galesville. VW #2 is planned to monitor several depths within the Mt. Simon; ADM should explore the feasibility of instrumenting this well to collect fluid samples in both the Ironton-Galesville and the St. Peter. This expanded monitoring would also allow ADM to collect sufficient information to inform AoR reevaluations and a non-endangerment demonstration. ADM should also describe or confirm in the plan that it will have access to all monitoring well locations throughout the injection and post-injection phases.

Why does ADM not plan to conduct any sampling in the Ironton-Galesville or St. Peter after baseline sampling is complete?

The proposed program of baseline sampling in the Ironton-Galesville without further fluid sampling unless there are anomalous pressure or Reservoir Saturation Tool (RST) results does not meet the requirement to periodically monitor ground water quality and geochemical changes above the confining zone per 40 CFR 146.90(d). it is suggested that GM #2 and VW #2 be appropriately instrumented and used for routine collection of fluid samples for geochemical analysis in the Ironton-Galesville (at a minimum) and the St. Peter (recommended) throughout the injection period.

What anomalous results from the pressure or RST data would ADM expect to see in order to trigger additional sampling (beyond baseline) in the Ironton-Galesville and the St. Peter?

While RST logs would indicate if CO_2 is leaking into the Ironton-Galesville, they would not indicate other changes such as an increase in total dissolved solids (TDS) or alkalinity. RST logs are not a substitute for required periodic ground water quality monitoring throughout the injection phase.

How will ADM select the locations and depths of the monitoring wells in the shallow Pennsylvanian and Quaternary formations?

Since AoR modeling is complete, Figure F1-1 (Nov. 2012), which shows approximate shallow ground water monitoring areas, should be refined to present the actual locations of these wells.

How did ADM select the parameters to be monitored and on what basis did ADM conclude that these are adequate to detect fluid movement or mobilization of contaminants? Why is TDS not a proposed measured parameter?

Additional analytes could include TDS, additional anions and cations, trace elements, and perhaps stable isotopes. Additional anions that could also be analyzed by the planned ion chromatography include sulfate and nitrate. Other cations that could be quantified using inductively coupled plasma spectrophotometry include: Al, Ba, Fe, K, Mg, K, Mn and Si. The trace elements As and Pb at a minimum could be included, as these are regulated under the Safe Drinking Water Act (SDWA). Stable isotopes might be considered as well; at least as a baseline on the CO_2 stream and fluids in case there is a future need for such monitoring (radon-222 analysis is proposed at the FutureGen site). Please note that, if baseline sampling and

analysis identifies other parameters of concern, these should be incorporated into the final Testing and Monitoring Plan.

How often does ADM plan to conduct ground water sampling and analysis?

The plan should describe the frequency and dates of sampling; quarterly sampling throughout the injection period (as is proposed for the Pennsylvanian and Quaternary formations) is likely reasonable. ADM should also specify triggers for increased sampling (frequency or parameters) in the event of evidence that the USDWs may be affected by injection activities.

How will ground water monitoring data be analyzed and what thresholds does ADM believe would indicate potential effects from injection activities?

Mechanical Integrity Testing (MIT)

How did ADM select intervals of 1, 3 and 5 hours after stopping injection to perform temperature logs to meet the requirements of 146.89(c)/146.90(e)?

Typically logs are taken for periods of at least 12 hours after injection has stopped to ensure that conditions have stabilized. It may be useful to require additional runs at longer time periods, e.g., up to 12 hours post-cessation. This may be a good approach at least for the first MIT and may not be needed for subsequent tests if the first MIT results are satisfactory.

Under what conditions would ADM run a pulsed neutron/RST or caliper log?

It would be beneficial to discuss the situations or criteria that would warrant such additional logs (although the planned temperature log is sufficient to meet the Class VI requirements).

Pressure Fall-Off Testing

When does ADM plan to conduct a pressure fall-off test to meet the requirements of 146.90(f)?

While the Class VI Rule requires pressure fall-off tests every five years, a test earlier than five years after injection begins may be appropriate since the proposed injection phase is only five years long and this frequency may not allow for any data collection during the injection phase or provide information to support an AoR reevaluation. ADM should also describe how it plans to evaluate the results of the test.

Plume and Pressure-Front Monitoring

Attachments 3 and 4 summarize EPA's understanding of where ADM proposes to conduct monitoring to meet the plume and pressure front tracking requirements at 40 CFR 146.90(g). Can ADM confirm that this is accurate? If it is inaccurate, please submit revised information.

Understanding this will help EPA evaluate whether the planned plume and pressure front tracking meets the Class VI Rule requirements. The Rule requires the use of direct methods to track the presence or absence of elevated pressure within the injection zone (40 CFR 146.90(g)(1)). It also requires the use of indirect methods for the purpose of tracking the extent of the CO_2 plume (40 CFR 146.90(g)(2)). On a project-specific basis, the UIC Program Director may require the use of direct methods to track the CO_2 plume where indirect methods yield

insufficient data. This data will also inform AoR reevaluations and a non-endangerment demonstration.

How will the proposed direct pressure monitoring at CCS #2 and VW #2 generate the data needed to verify the modeled predictions of plume and pressure front movement and meet the requirements at 40 CFR 146.90(g)(1)?

Please provide a description of when elevated pressures are expected to arrive at the different perforated intervals of VW #2 based on the AoR modeling results and how monitoring data will be generated to confirm these predictions. Also, provide maps of predicted pressure distribution at the project site at various times during the injection and post-injection phases (e.g., contours showing the predicted pressure differentials around the injection well) and a description of how the direct monitoring data may be used to confirm these predictions.

How will seismic data be processed and analyzed to produce pressure estimates to meet the indirect pressure monitoring requirements at 40 CFR 146.90(g)(2)?

Will the seismic surveys described in the permit application materials be used for indirect pressure-front monitoring as well as indirect CO_2 plume monitoring? If these surveys will be used to provide indirect pressure data, please provide:

- A detailed description of how time-lapse vertical seismic profile (VSP) surveys and surface seismic surveys will be used to provide sufficient temporal and spatial coverage for pressure-front tracking (pressure-front as identified based on the updated modeling methodology, or the area determined to experience any elevated pressures based on the modeling results) including the area that is predicted to have elevated pressures (given that time-lapse VSP surveys' spatial coverage is indicated as 2,500 ft radius);
- A detailed schedule for both types of surveys to ensure that model predictions can be verified;
- A detailed description of surface seismic surveys and the data that they will generate for pressure measurements; and
- A detailed description of time-lapse VSPs and the data that they will generate for pressure measurements.

How will the data that will be generated by RST, time-lapse VSP surveys, and surface seismic surveys meet the indirect plume monitoring requirements at 40 CFR 146.90(g)(2)?

The literature indicates that RST logging can be used to determine residual saturation of CO_2 after injection. Will this be implemented? Will the RST results be used to capture breakthrough (i.e., into different zones within the Mt. Simon) for verifying the modeling predictions? Is it anticipated that annual RST logging during the injection phase will be frequent enough to capture this?

According to the most recent permit application submission, "In the early stages of injection, time-lapse 3D VSPs will likely be used to image the developing CO_2 plume." What is the planned timing/frequency of these surveys? How will these surveys provide enough spatial coverage for tracking the overall plume?

ADM states in the most recent permit application submission that, "At the end of the injection period, either a series of 2D surface seismic lines or a final time-lapse 3D surface seismic survey may be utilized to image the final plume." What is the anticipated spatial extent of this seismic monitoring? Will it cover areas of the AoR not covered by other monitoring techniques (e.g., the southern part of the AoR, the fringes of the AoR)?

Why does ADM not plan to directly monitor the plume within the injection zone?

How will indirect plume monitoring provide sufficient information to verify the predicted modeling results? How will ADM use the baseline data collected from the injection zone?

Well Plugging Plan

What type of MIT does ADM plan to perform prior to plugging the injection well?

The planned well plugging procedures mention neutron, ultrasonic, calipers and a cement bond log. While all these logs are useful and should be encouraged, the rule requires either a temperature log, noise log or tracer log after injection has ceased and before the well is plugged (40 CFR 146.92 (b)(2)).

Post-Injection Site Care (PISC) and Site Closure Plan

How does ADM plan to collect sufficient information on which to base the non-endangerment demonstration required at 40 CFR 146.93(b)?

Based on the planned injection and post-injection monitoring programs described in the permit application, it does not appear that ADM plans to collect sufficient amounts and types of data (e.g., pressure monitoring and seismic surveys) over a large enough area of the AoR to support a non-endangerment demonstration at the end of the proposed PISC timeframe. (See the questions regarding the proposed testing and monitoring for further discussion of these concerns.)

Additional information is needed to fully evaluate the PISC and Site Closure Plan and whether financial responsibility coverage for these activities is adequate. Please provide the following:

- Pre-injection and predicted post-injection pressure differentials based on the revised AoR modeling (supported by a figure depicting the distribution of this pressure differential over the spatial extent of the model domain, e.g., contour plot);
- The predicted plume and pressure front position at site closure, updated based on the revised AoR modeling;
- Specific information on the depths of plugs and schematics based on the as-built monitoring and geophysical well(s); and
- Additional information to evaluate the appropriateness of the 10-year alternative PISC timeframe is also needed; this is requested separately in the document “ADM’s CCS #2 Permit Application Alternative PISC Timeframe Demonstration Review”.

Emergency and Remedial Response Plan

Who does ADM plan to notify first of any events that may constitute an emergency, as required at 40 CFR 146.94?

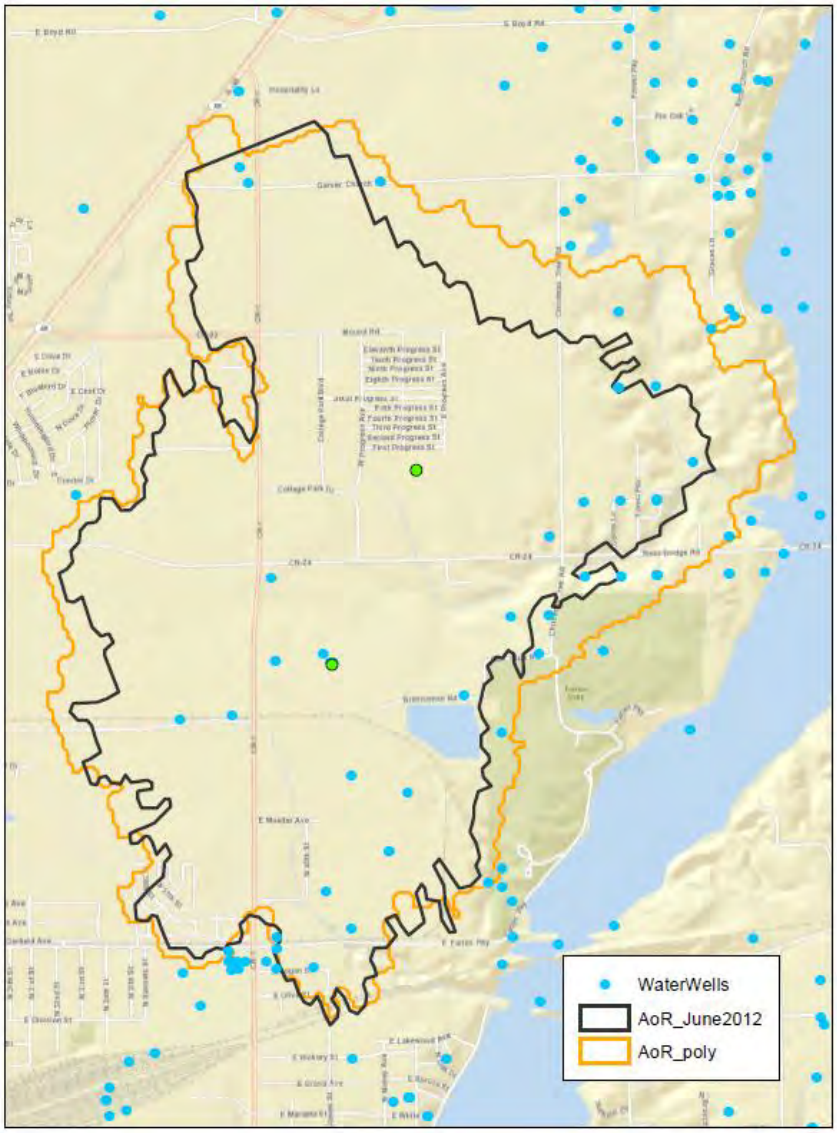
It appears that ADM supervisors would be notified first, followed by notification of EPA after ADM has made a determination regarding the severity of the event. This could be as long as 24 hours after the incident has occurred and does not meet the intent of the Class VI Rule's notification requirements at 146.94(b)(3). It is recommended that any event that triggers an investigation (even if it does not turn out to constitute an emergency) be reported to EPA as soon as possible.

What steps would ADM take in the event of an induced seismic event?

The Emergency and Remedial Response Plan should address this possibility.

Please also provide contact information for all responding personnel (e.g., name, phone number, email). In the event that the plan is implemented, current contact information for personnel would facilitate communications and prompt and appropriate responses. The list should also be provided to all involved parties and be readily available at the control center.

Attachment 1



Comparison of the AoR submitted in June 2012 with the updated Section 5, Figure 5-2 (as shown in black and labeled "AoR_June2012") with the AoR shape file that was submitted with the Input Advisor on February 8, 2013 (shown in yellow and labeled "AoR_poly").

Attachment 2

Proposed injection phase ground water monitoring activities for IL-ICCS/CCS #2 above the confining zone. "Reference" points to primary citations within ADM's permit application materials, referred to by date: Jul. 2011 – original CCS #2 permit application, Dec. 2011 – original CCS #1 permit application, Nov. 2012 – response to second request for additional information.

Monitoring Category and Class VI Rule Citation	Monitoring Activity and Target Formation	Data Collection Location(s)	Spatial Coverage	Temporal Coverage (Inj. Phase)	Reference	Notes
Ground water monitoring above the confining zone [40 CFR 146.90(d)]	Quaternary and/or Pennsylvanian strata fluid sampling	Shallow wells	Point locations (4)	Quarterly	Nov. 2012, App. F1	"Voluntary" sampling—results will not be submitted with monitoring reports.
	St. Peter fluid sampling	GM #2	Point location	None: baseline only	Nov. 2012, App. F2	No data to be collected during the injection phase.
	St. Peter pressure monitoring	GM #2	Point location	Not specified	Jul. 2011, p. 3C-4; Nov. 2012, App. F2	Schedule/frequency not specified.
	Ironton-Galesville fluid sampling	VW #1	Point location	None: baseline only	Nov. 2012, App. F3	No data to be collected during the injection phase.
	Ironton-Galesville pressure monitoring	VW #1	Point location	Continuous	Dec. 2011, § 3.2.6; Nov. 2012, App. F3	

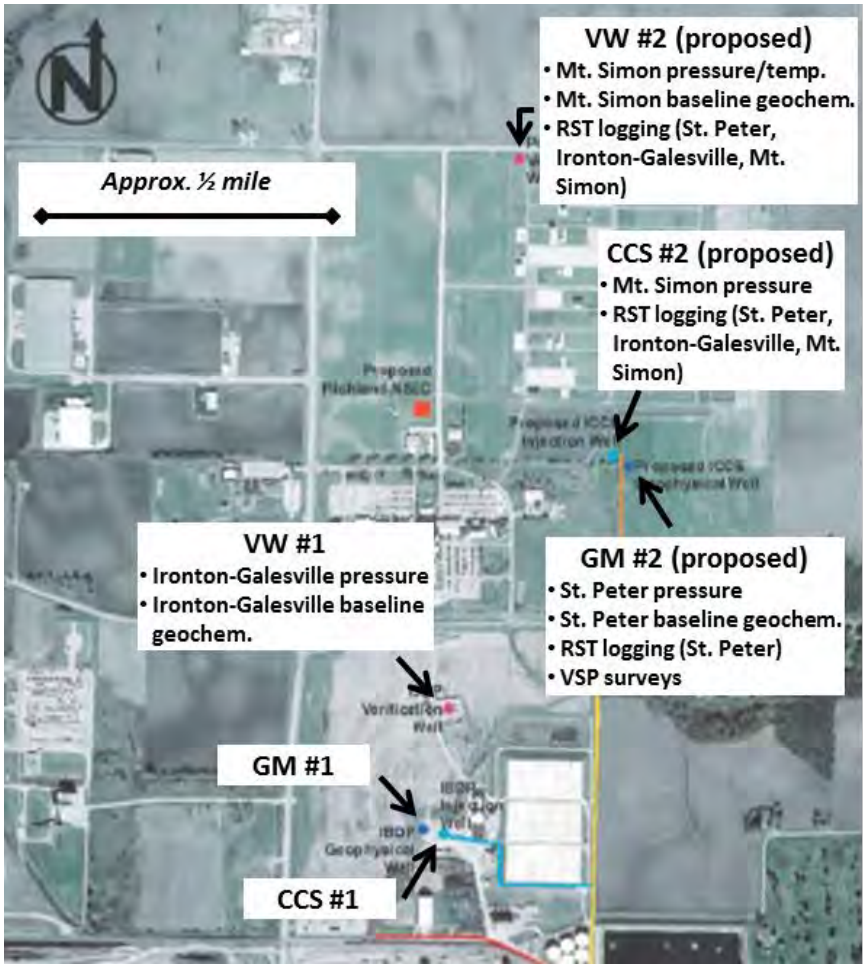
Attachment 3

Proposed injection phase plume and pressure front monitoring activities for IL-ICCS/CCS #2. "Reference" points to primary citations within ADM's permit application materials, referred to by date: Jul. 2011 – original CCS #2 permit application, Dec. 2011 – original CCS #1 permit application, Nov. 2012 – response to second request for additional information.

Monitoring Category and Class VI Rule Citation		Monitoring Activity and Target Formation	Data Collection Location(s)	Spatial Coverage	Temporal Coverage (Inj. Phase)	Reference	Notes
Plume Monitoring	**Direct** [40 CFR 146.90(g)(1)]	Mt. Simon fluid sampling	VW #2	Point location	None: baseline only	Nov. 2012, App. F4	No data to be collected during the injection phase.
	Indirect [40 CFR 146.90(g)(2)]	St. Peter RST logging	GM #2	Point location	Annual	Nov. 2012, App. F2	
			VW #2	Point location	Annual	Nov. 2012, App. F2	
			CCS #2	Point location	Annual	Nov. 2012, App. F2	
		Ironton-Galesville RST logging	VW #2	Point location	Annual	Nov. 2012, App. F3	
			CCS #2	Point location	Annual	Nov. 2012, App. F3	
		Mt. Simon RST logging	VW #2	Point location	Annual	Nov. 2012, App. F4	
			CCS #2	Point location	Annual	Nov. 2012, App. F4	
		Time-lapse VSP surveys (multiple formations)	GM #2	2,500 ft radius	"Early stages of injection"	Nov. 2012, § 6A.2.5	Schedule/frequency not specified.

Monitoring Category and Class VI Rule Citation		Monitoring Activity and Target Formation	Data Collection Location(s)	Spatial Coverage	Temporal Coverage (Inj. Phase)	Reference	Notes
		Surface seismic surveys (multiple formations)	Not specified	Not specified	"End of the injection period"	Nov. 2012, § 6A.2.5	Schedule and details (e.g., type, extent of survey) not specified. Not clear if data will be collected during the injection phase.
Pressure-front Monitoring	**Indirect** [40 CFR 146.90(g)(2)]	Time-lapse VSP surveys (multiple formations)	GM #2	2,500 ft radius	"Early stages of injection"	Nov. 2012, § 6A.2.5	Schedule/frequency not specified. Not clear if data will be analyzed to produce pressure estimates.
		Surface seismic surveys (multiple formations)	Not specified	Not specified	"End of the injection period"	Nov. 2012, § 6A.2.5	Schedule and details (e.g., type, extent of survey) not specified. Not clear if data will be collected during the injection phase. Not clear if data will be analyzed to produce pressure estimates.
	Direct [40 CFR 146.90(g)(1)]	Mt. Simon pressure and temperature monitoring	VW #2	Point location	Continuous	Nov. 2012, § 6B.2 and App. F4	Location of VW #2 relative to predicted pressure front movement is uncertain.
			CCS #2	Point location	Continuous	Nov. 2012, § 6A.2.5 and App. F4	

Attachment 4



Location of injection wells and deep monitoring wells at the ADM site, with the planned monitoring activities for the IL-ICCS/CCS #2 project for each applicable well.

Enclosure 2

Archer Daniels Midland (ADM) CCS #2 Permit Application
Alternative Post-Injection Site Care (PISC) Timeframe Demonstration Review

Summary: EPA requests that ADM submit a separate, complete, revised alternative PISC timeframe demonstration that addresses all the criteria at 40 CFR 146.93(c) and is based on the results of the most recent information submitted to EPA.

Section I: Background and Context

Summary of Relevant Class VI Requirements

Pursuant to 40 CFR [Code of Federal Regulations] 146.93(c), the Underground Injection Control (UIC) Program Director may, in consultation with EPA, approve an alternative PISC timeframe other than the 50-year default if an owner or operator can demonstrate during the permitting process that an alternative PISC timeframe is appropriate and ensures non-endangerment of USDWs. In order for such a request to be approved, an owner or operator must demonstrate, based on significant, site-specific data and information, including all data and information collected pursuant to 40 CFR 146.82 and 146.83, that the injection project will no longer pose a risk of endangerment to Underground Sources of Drinking Water (USDWs) at the end of the proposed alternative timeframe.

The Class VI Rule, at 40 CFR 146.93(c)(1) and (2), specifies the information and analyses that must be provided by the applicant for this demonstration based on the Area of Review (AoR) delineation modeling results and on the site characterization data submitted.

In addition to the information required at 40 CFR 146.93(c), the proposed testing and monitoring are critical to evaluating the appropriateness of an alternative PISC timeframe because the testing and monitoring data generated will be necessary for:

(1) Confirming and verifying the results of the model predictions that are used for delineating the AoR and supporting the decision for an alternative PISC timeframe (e.g., during the periodic AoR reevaluations); and

(2) Eventually evaluating and approving the non-endangerment demonstration prior to site closure, pursuant to 40 CFR 146.93(b)(3).

Summary of Information Previously Submitted

Section 9.1 of the original permit application (submitted in July 2011) requests a modified PISC timeframe of 10 years and notes that this PISC period is based on current monitoring and other site-specific data (i.e., data available in July 2011) that demonstrate that the sequestered CO_2 will no longer endanger USDWs at the end of the PISC period and will meet the requirements for an alternative PISC period as detailed in 40 CFR 146.93(c)(1) and (2). However, this alternative PISC timeframe description/demonstration was based on the initial AoR delineation efforts (also submitted in July 2011 with the original permit application) and was not updated to reflect any subsequent submissions or analyses. Specifically, Section 9 has not been updated to reflect the revised AoR delineation modeling materials submitted in and after June 2012 and site characterization information submitted in January

2012. Furthermore, the demonstration provided in Section 9, does not address all the criteria at 40 CFR 146.93(c)(1) and (2).

Conclusion

To comply with the Class VI Rule requirements, EPA requests that ADM submit a separate, complete, revised alternative PISC timeframe demonstration that addresses all the criteria at 40 CFR 146.93(c) and is based on the results of the most recent information including the modeling approach used to delineate the final AoR.

Section II: Instructions to Guide Demonstration Revisions

In the interest of time and with the goal to facilitate the development of the revised alternative PISC timeframe demonstration, we have evaluated the information submitted in Section 9 of the original permit application for each criterion under 40 CFR 146.93(c)(1) and (2), and extracted the necessary and relevant information from the initial permit application, subsequent submittals, and responses to Notices of Deficiency.

The following sections of this document evaluate a 10-year alternative PISC timeframe against the requirements of the Class VI Rule (shown in ***bold italics***), describe what was submitted for the original PISC timeframe demonstration in July 2011 and discuss the updated data submitted in subsequent documents (i.e., the new AoR delineation modeling information submitted in June 2012 and the data submitted with the Input Advisor in January 2013). It also evaluates how the most up-to-date information may support a request for a 10-year alternative PISC timeframe and identifies the additional information needed to support a full evaluation of the appropriate PISC timeframe. EPA encourages the use of the information below in as much as it supports development of a complete alternative PISC timeframe demonstration. However, if ADM has additional or alternative information to support compliance with 40 CFR 146.93(c), such information may also be submitted in response to this request.

To facilitate the comparison of information submitted at different times, ADM's submittals will be referenced by their respective dates:

- July 2011: ADM's original permit application submission
- January 2012: ADM's first revision to the permit application
- June 2012: ADM's revised AoR delineation modeling submission
- January 2013: ADM's Input Advisor submission

40 CFR 146.93(c)(1) A demonstration of an alternative post-injection site care timeframe must include consideration and documentation of:

(i) The results of computational modeling performed pursuant to delineation of the area of review under § 146.84;

Please provide a discussion of how the proposed testing and monitoring activities will be used to verify and update the site characterization and modeling information.

Section 9.1.3 of the July 2011 permit application states *"*The results of computational modeling of the project (Section 5.4 of this application) indicate that the sequestered CO_2 will not migrate

above the Mt. Simon Sandstone" in response to this criterion (p. 9-3). The section to which this statement refers is the older version of the AoR delineation modeling section, which later was completely revised and replaced with the June 2012 submittal.

The modeling results presented in the June 2012 document and the Input Advisor submittals can be used to support this part of the alternative PISC timeframe demonstration. The cross-sectional views presented by ADM in the revised modeling description (June 2012, Figs. 5-6 through 5-17) predict that the CO_2 plume will remain in the lower zone of the Mt. Simon, below about 5,600 ft beneath the surface, approximately 43 years after the end of injection into CCS #2 (June 2012, p. 5-24).

However, these results strongly depend upon the completeness, accuracy, and quality of site characterization and modeling results. Therefore, a discussion of how the proposed testing and monitoring activities will be used to verify and update the site characterization and modeling information is also needed.

(ii) The predicted timeframe for pressure decline within the injection zone, and any other zones, such that formation fluids may not be forced into any USDWs; and/or the timeframe for pressure decline to pre-injection pressures;

Please submit a description of pressure decline within the injection zone and in the confining zone based on the new AoR delineation modeling results in the form of pressure distributions at specific elevations and times (e.g., at the start of injection, at the end of injection, and a series of distributions indicating dissipation and the necessary timeframe).

Section 9.1.3 of the July 2011 permit application (p. 9-3) includes the following information in support of this criterion: "The formation pressure at the injection well is predicted to decline rapidly within the first 4 years following injection (formation pressure pre-injection = 2,840 psia, immediately following injection = 3,340 psia, 4 years post-injection = 2,950 psia). Fifty years post-injection, the formation pressure is predicted to be 2,860 psia. Furthermore, the increase in the injection formation pressure at the edge of the AoR is expected to be less than 185 psi at the cessation of injection, less than 110 psi 4 years later, and continues dropping to less than 10 psi at the end of fifty years."

In the February 2013 Input Advisor submission, ADM submitted an initial aqueous pressure in the injection zone of 3,205 psi at a reference elevation of -6,345 ft. Because the reference elevation was not provided in the July 2011 submission, it is not clear how this initial aqueous pressure compares to the information given above.

Based on the revised modeling results, the pressure buildup in the system may be expected to stay below a critical level (compared to fracture pressure) and dissipate within 4–6 years following the cessation of injection at CCS #2. In the AoR modeling results (June 2012, Figs. 5-6 through 5-17), pressure declines to near-pre-injection levels approximately 4 years after injection ends, and the predicted extent of the pressure front is smaller than the extent of the CO_2 plume.

(iii) The predicted rate of carbon dioxide plume migration within the injection zone, and the predicted timeframe for the cessation of migration;

Please provide information on the predicted rate of migration within the injection zone.

In the original alternative PISC timeframe demonstration, the rate of plume migration or the predicted timeframe for the cessation of migration were not discussed with respect to the alternative PISC timeframe. However, as shown in Figures 5-6 through 5-18 of the June 2012 AoR submission, nearly all plume migration occurs by Year 18 of the simulation (11 years after injection ends), with minimal movement continuing through Year 50 of the simulation. It is stated that "From this figure it can be seen that the plume growth during the 32 year period is minimal indicating the plume has become stable" (June 2012, p. 5-10).

Therefore, the predicted rate of migration within the injection zone must be specifically provided as part of the demonstration for alternative PISC timeframe.

(iv) A description of the site-specific processes that will result in carbon dioxide trapping including immobilization by capillary trapping, dissolution, and mineralization at the site;

Please provide an updated discussion of the site-specific processes that will result in CO_2 trapping or immobilization based on the June 2012 AoR delineation modeling results.

This criterion is briefly described in the original AoR submission as follows: "A second notable observation [in the figures displaying the model results] is that the brine displaced ahead of the advancing CO_2 plume created by the injection into CCS #2 not only distorts the shape of the plume around CCS #1, but also sweeps away mobile CO_2 from the nearest edges of the plume, leaving behind a 'shadow' of residually-trapped CO_2. This affect [sic] is most apparent when comparing the Year 3 and Year 7 cross-sectional views in Figure 5-8. The CO_2 that is residually trapped as a result of the encroaching brine is depicted in light-blue, or the 0.2 – 0.25 range in the CO_2 saturation color bar. This residually-trapped CO_2 is immobilized by capillary forces and can be seen to persist through the remaining cross-sectional images in Figure 5-8, suggesting long-term storage in the lower Mt. Simon" (July 2011, p. 5-5; Jan. 2012, p. 5-6).

However, trapping is not discussed in the revised AoR submission from June 2012 or in any other subsequent permit application materials, and an updated discussion on the site-specific processes that will result in CO_2 trapping or immobilization based on the June 2012 AoR delineation modeling results should be provided. It is expected that capillary trapping and dissolution are the major mechanisms that affect the CO_2 mobility in the injection zone.

(v) The predicted rate of carbon dioxide trapping in the immobile capillary phase, dissolved phase, and/or mineral phase;

Please provide a discussion of the predicted amounts for dissolved and trapped phases of CO_2 as a fraction of the total amount injected.

See above; this does not appear to be specifically discussed in the permit application. The information submitted for the previous criterion should be supported by a discussion of the predicted amounts for dissolved and trapped phases of CO_2 as a fraction of the total amount

injected at the end of a 10-year PISC period and at the end of the 52-year simulation period (i.e., corresponding to about a 45-year PISC timeframe).

(vi) The results of laboratory analyses, research studies, and/or field or site-specific studies to verify the information required in paragraphs (iv) and (v) of this section;

Please describe any laboratory analyses, research studies, and/or field or site-specific studies relevant to the predicted CO_2 trapping.

This is not specifically discussed or addressed in any of the submittals and must be discussed with respect to the alternative PISC timeframe.

(vii) A characterization of the confining zone(s) including a demonstration that it is free of transmissive faults, fractures, and micro-fractures and of appropriate thickness, permeability, and integrity to impede fluid (e.g., carbon dioxide, formation fluids) movement;

Please provide current, relevant information on the suitability of the confining zones as described in the sections below.

In Section 9.1.3 of the July 2011 permit application, it is stated that "The hydrogeologic and seismic characterization for the project site indicates that the Eau Claire Formation, the primary seal above the Mt. Simon, does not contain any faults and has permeability sufficiently low to impede CO_2 migration to overlying formations" (pp. 9-3 and 9-4).

In Section 2.2 of the January 2012 permit application revision, it is reported that 3D seismic reflection data collected for the Illinois Basin – Decatur Project (IDBP)/CCS #1 project indicate that there are no resolvable faults in the Eau Claire. In Section 2.5, an assessment of the Eau Claire's lithology, geomechanical properties, permeability and hydraulic conductivity, with site-specific information primarily based on CCS #1 core analysis was provided. It was also noted that "gas storage projects in the Illinois Basin confirm that the Eau Claire is an effective seal in the northern and central portions of the Basin" (Jan. 2012, p. 2-18). One diagrammatic cross section of Cambrian strata through central Illinois (Jan. 2012, Fig. 2-20) was provided, which is intended to demonstrate that the Eau Claire has "a [regionally] laterally persistent shale interval above the Mt. Simon and is expected to provide an excellent seal" (Jan. 2012, p. 2-18), though this is difficult to determine based on the scale and quality of the image.

According to the information submitted, in the area of the proposed injection well, the Eau Claire consists of an approximately 200 ft thick basal shale layer overlain by approximately 300 ft of very fine-grained limestone interbedded with thin siltstone layers (Jan. 2012, p. 2-19). Tests of sidewall rotary core samples from the upper limestone/siltstone unit indicate an average vertical permeability of 0.000344 mD; the average vertical permeability for the lower shale unit is expected to be "much lower" as "vertical permeability on plugs is generally lower than horizontal permeability and shale permeability is generally much lower than sandstone, limestone, and siltstone" (Jan. 2012, p. 2-20). Based on the analysis of log results from CCS #1, the 317 ft thick Eau Claire is described as having "only a few small intervals of less than a few feet that have any permeability greater than 0.1 mD," which "do not appear to be continuous" (Jan. 2012, p. K-5).

Moving to regional data, a state database of injection well core samples was reviewed and a median permeability value of 0.000026 mD for the Eau Claire was found, with a median porosity of 4.7% (Jan. 2012, p. 2-21). A set of core samples from a gas storage field approximately 80 miles to the north of the proposed Class VI location was also described. Of the 110 analyses conducted, most were in the range of < 0.001 to 0.001 mD, with five in the range of 0.100 to 0.871 mD (the maximum value in the data set). It is stated that this "indicates that even the more permeable beds in the Eau Claire Formation are expected to be relatively tight and tend to act as sealing lithologies" (Jan. 2012, p. 2-21). Core analysis data from another gas storage field, 37 miles to the northeast of the proposed site, with vertical Eau Claire shale permeabilities of less than 0.1 mD (Jan. 2012, p. 2-18) were also cited.

The information submitted in various sections of the permit application and subsequent updates as summarized above, along with a new brief discussion of how this information will be verified with the proposed testing and monitoring activities, would be sufficient to support the required criteria at 40 CFR 146.9(c)(1)(vii) for characterizing the confining zone(s) for the alternative PISC timeframe demonstration.

(viii) The presence of potential conduits for fluid movement including planned injection wells and project monitoring wells associated with the proposed geologic sequestration project or any other projects in proximity to the predicted/modeled, final extent of the carbon dioxide plume and area of elevated pressure;

Please provide current, relevant information on potential conduits for fluid movement as described in the sections below.

In Section 9.1.3 of the July 2011 permit application, it is stated that, "Potential conduits of CO_2 migration above the Mt. Simon are limited to the IBDP injection and verification wells or the IL-ICCS injection and verification wells, all of which will be constructed, monitored, and plugged in a manner that will minimize the potential for any such migration and meets the requirements of 40 CFR Part 146" (p. 9-4).

In the June 2012 AoR delineation submission, this finding is repeated and it is reiterated that the evaluation of all identified wells within a 3.2 km (2.0 mile) radius of the ICCS site showed no other wells in this area that penetrate the Eau Claire Formation (pp. 5-24 and 5-25).

The construction plans for the verification well and geophysical wells, which include the use of CO_2- resistant materials in the lower half of the wells, indicate that these wells would not become conduits for unacceptable fluid movement.

Identification of the current, relevant information is needed and should be included in the revised demonstration.

(ix) A description of the well construction and an assessment of the quality of plugs of all abandoned wells within the area of review;

No additional information is needed.

As there are apparently no abandoned deep wells in the AoR, this criterion does not apply.

(x) The distance between the injection zone and the nearest USDWs above and/or below the injection zone; and

Please provide current, relevant information on the distance between the injection zone and the nearest USDWs as described below.

In Section 9.1.3 of the July 2011 permit application, it is stated that, "The Mt. Simon Sandstone is nearly 7,000 feet below the lowermost USDW, and there are three confining formations (New Albany Shale, Maquoketa Formation, Eau Claire Formation) between the injection zone and the lowermost USDW" (p. 9-4).

As the alternative timeframe submission has not been updated since July 2011, the submitted materials consider the lowermost USDW to be the Pennsylvanian bedrock rather than the St. Peter Sandstone. The vertical distance between the base of the St. Peter and the top of the Mt. Simon is approximately 2,000 ft rather than 7,000 ft; this distinction is particularly important to note because the vertical distance between the injection zone and lowermost USDW is a factor in the pressure front calculations. In addition, the New Albany and the Maquoketa lie above the St. Peter in the stratigraphic column and so they cannot serve as confining formations between the injection zone and the lowermost USDW.

Identification of the current, relevant information is needed and should be included in the revised demonstration.

(xi) Any additional site-specific factors required by the Director.

No additional information is needed.

Not applicable at this time.

(2) Information submitted to support the demonstration in paragraph (c)(1) of this section must meet the following criteria:

(i) All analyses and tests performed to support the demonstration must be accurate, reproducible, and performed in accordance with the established quality assurance standards;

Please provide a description of the quality assurance standards for all analyses and tests performed to support the alternative PISC timeframe demonstration.

This criterion was not addressed in Section 9. However, most of the data used for the alternative PISC demonstration are site characterization data and the modeling information. A description of the quality assurance standards used is needed.

(ii) Estimation techniques must be appropriate and EPA-certified test protocols must be used where available;

Please describe how all estimation techniques used to support the alternative PISC timeframe demonstration were appropriate and used EPA-certified test protocols.

See above; this does not appear to be specifically discussed in the permit application. A description is needed.

(iii) Predictive models must be appropriate and tailored to the site conditions, composition of the carbon dioxide stream and injection and site conditions over the life of the geologic sequestration project;

Please submit a description of how the AoR delineation that supported the alternative PISC timeframe demonstration was appropriate to the site conditions and the carbon dioxide stream.

The AoR delineation model appears to be consistent with the requirements under 40 CFR 146.84. A description is needed.

(iv) Predictive models must be calibrated using existing information (e.g., at Class I, Class II, or Class V experimental technology well sites) where sufficient data are available;

Please describe how the models were calibrated and how proposed testing and monitoring activities will generate the necessary information to confirm/verify the modeling results.

This criterion also doesn't appear to be addressed in the original permit application. In the June 2012 AoR delineation updates, it is indicated that operational and monitoring data from the IDBP/CCS #1 project were used for calibrating the reservoir model (p. 5-5). Data obtained (injection well bottom hole pressure data, multi-zone pressure data from VW #1, injection profile logs from CCS #1, and data from reservoir saturation tools) were used to calibrate various parameters including intrinsic permeabilities, relative permeabilities, wellbore skin, vertical to horizontal permeability ratios, and rock compressibility. A description is needed for this demonstration which also includes how proposed testing and monitoring activities will generate the necessary information to confirm/verify the modeling results and the site characterization information used.

(v) Reasonably conservative values and modeling assumptions must be used and disclosed to the Director whenever values are estimated on the basis of known, historical information instead of site-specific measurements;

Please describe how reasonably conservative values and modeling assumptions were used to support the alternative PISC timeframe demonstration.

This criterion is not specifically discussed in the demonstration, though the majority of input/calibration data for the model are site-specific (i.e., from the IDBP/CCS #1 project). A description is needed for this demonstration.

(vi) An analysis must be performed to identify and assess aspects of the alternative post-injection site care timeframe demonstration that contribute significantly to uncertainty. The owner or operator must conduct sensitivity analyses to determine the effect that significant uncertainty may contribute to the modeling demonstration.

Please submit sensitivity analyses for residual aqueous saturation values.

This has not been provided by the permit applicant. The residual aqueous saturation values used in the AoR modeling effort are relatively high compared to the values that are reported in the literature for the Mt. Simon Sandstone and indicate zero aqueous permeability at moderate aqueous saturations. It is recommended that ADM submit a set of sensitivity analyses for these values since the source of this information was not discussed in great detail in the submittals.

(vii) An approved quality assurance and quality control plan must address all aspects of the demonstration; and,

Please submit a quality assurance and quality control plan for all analyses that support the alternative PISC timeframe demonstration.

A brief quality assurance statement as part of the monitoring plan submissions was provided in the original submittal. No quality assurance information has been submitted specifically with regard to data on which the alternative PISC timeframe request is based.

(viii) Any additional criteria required by the Director.

No additional information is needed.

Not applicable at this time.

Enclosure 3

In accordance with 40 CFR 144.4 (c), the U. S. Environmental Protection Agency (EPA) is required to comply with the Endangered Species Act (ESA) when issuing permit decisions. Therefore, when considering a permit application or extension, the UIC Branch must consider the potential impacts from the new or existing injection well to endangered species present in the area. In order to determine whether an injection well will adversely impact endangered and threatened species, the UIC branch must have location-specific ecological information, such as the presence of certain vegetation, soils or surface water bodies. The U.S. Fish and Wildlife Service has listed the following in Macon County:

Macon **Field Office to Contact:** U.S. Fish and Wildlife Service Rock Island Illinois Field Office 1511 47th Avenue Moline, Illinois 61265 (309) 757-5800 e:mail RockIsland@fws.gov FAX: 309-757-5807	Indiana bat *(Myotis sodalis)*	Endangered	Caves, mines (hibernacula); Small stream corridors with well developed riparian woods; upland forests (foraging)
	Eastern prairie fringed orchid *(Platanthera leucophaea)*	Threatened	Mesic to wet prairies

As a result, we are requiring the following information to be submitted in each permit application.

a. A summary of the critical habitat which, if present, may support one of the above-listed species. Detailed information on critical habitat can be found at the following web address: http://www.fws.gov/midwest/endangered/section7/s7process/lifehistory.html.

b. A survey of the surface vegetation, soils, topography and hydrologic features in the action area in sufficient detail to address the presence or absence of critical habitat for any endangered, threatened, or candidate species. This will include descriptions such as "mature mixed forest", "plowed field" or "stabilized dunes", and may also include specific trees or plants listed as critical to a species.

c. A description of the action area for the well and associated surface facilities. This will include dimensions of the affected area, such as the clearing in which the well is located, length of road or pipeline to be built, etc., as well as the extent of disruption of the area. For example, an existing well with no construction plan will be less disruptive than a proposed well, and a proposed well in an open, plowed field will be less disruptive than one which requires some clearing of forest.

This information must be certified in accordance with 40 CFR 144.32(d). EPA recommends that this information be gathered in consultation with an ecologist, botanist, or other environmental professional.

If critical habitat is present, the permit is not automatically denied. EPA, in conjunction with the U.S. Fish and Wildlife Service, will examine more detailed information to determine the presence of endangered species in the area and the likelihood of negative impact to the species. Past experience has shown that very few projects pose any disturbance to endangered species in Region 5, and we do not expect this to change. We appreciate your cooperation in protecting these important species from endangerment and extinction.

Enclosure 4

References still needed for ADM permits

It is only necessary to provide the portions of a cited material that is the basis of support for the statement in the application.

ICCS; IL-115-6A-0001; CCS #2

Page	Citation
*2-2	Leetaru, H., 2011. Personal communication, Illinois State Geological Survey
*2-5	Morse, D.G., and H.E. Leetaru, 2005. Reservoir characterization and three-dimensional models of Mt. Simon Gas Storage Fields in the Illinois Basin: Illinois State Geological Survey, Circular 567, 72 p. CD-ROM.
2-13	Southeastern Wisconsin Regional Planning Commission and Wisconsin Geological and Natural History Survey, 2005. A Regional Aquifer Simulation Model for Southeastern Wisconsin, Southeastern Wisconsin Regional Planning Commission Technical Report 41**:** 143.
*2-13	Zimmerman, R.W., 1991. Compressibility of sandstones, Elsevier Publishing Co., Amsterdam.
2-18	Larson, K.R., 1965. Exhibit 25: Core Analyses. In the matter of the Application of the Peoples Gas Light and Coke Company for an order and certificate of convenience and necessity to develop, construct, operate and maintain the Mahomet Storage Field in Champaign and Piatt Counties, Illinois Commerce Commission, Docket No. 51416 [Unpublished data, a copy of which is available for inspection at the Library of the Illinois State Geological Survey, Champaign IL].
*2-21	Illinois State Geological Survey Mt. Simon database
2-25	Buschbach, T.C., 1964. Cambrian and Ordovician Strata of Northeastern Illinois, Illinois State Geological Survey, Report of Investigations 218, 90 p.
*2-29	Illinois State Geological Survey, 2006. Directory of Coal Mines in Illinois, Logan County, 10 p.
*2-29	Illinois State Geological Survey, 2006. Directory of Coal Mines in Illinois, Macoupin County, 17 p.
*2-30	Various years, Illinois Annual Oil Field Reports, Illinois State Geological Survey
*2-31	Byers, D., 2011. Personal communication, Illinois State Geological Survey
*2-31	Kolata, D.R., 2005. Bedrock Geology of Illinois, Illinois State Geological Survey Illinois Map 14: 1:500,000.
*2-31	Loyd, O,B. and W.L. Lyke, 1995. Ground Water Atlas of the United States, Segment 10: Illinois, Indiana, Kentucky, Ohio and Tennessee, United States Geological Survey Hydrologic Investigations Atlas 730-K, 30 p
*2-31	V. Smith, personal communication, Schlumberger Carbon Services, 2011
*3A-16	Robinson, J. 2003. Personal communication, Franklin Well Services, Lawrenceville, Illinois
*3A-16	Howard, G. C. and C.R. Fast. 1970. Hydraulic Fracturing, New York Society of Petroleum Engineers of AIME, 210 p.
*5-29	Bethke, C. M. (2006). *The Geochemist's Workbench (Release 6.0) Reference Manual.* Golden, CO: Rockware, Inc.
*5-29	Zaytsev, I. D., & Aseyev, G. G. (1992). *Properties of Aqueous Solutions of Electrolytes.* Boca Raton, FL: CRC Press
6A-15	Arts, R., and P. Winthaegen, 2005, Monitoring Options for CO2 Storage. In Carbon Dioxide Capture for Storage in Deep Geologic Formations, Volume 2. Eds. D.C. Thomas and S.M. Benson. Amsterdam: Elsevier, 2005.1001-1013.
App H	Hvorslev, M.J., 1951. Time lag and soil permeability in ground-water observations, Waterways Experiment Station Bulletin No. 36, U.S. Army Corps of Engineers, Vicksburg,

	Mississippi, 50 p.
App H	Jorgensen, D.G., 1995. The Ratio Method of Estimating Water Resistivity and TDS from Resistivity Logs, **Ground Water 34**(3): 519-522.
App H	Moye, D.G., 1967. Diamond drilling for foundation exploration, **Civil Engineering Transactions 9**: 95-100.
App H	Pryor, W.A., 1956. Quality of Groundwater Estimated from Electric Resistivity Logs, Illinois State Geological Survey Circular 215, 15 p.
App H	Schnobelen, D.J., E.F. Bugliosi, and N.C. Krothe, 1995. Delineation of a Saline Groundwater Boundary from Borehole Geophysical Data, **Ground Water 33**(6):965-976.

*Items marked with an asterisk are also cited in the application for CCS #1. If the citation is referencing the same information, it need only be submitted once and noted that it applies to both.

IBDP; IL-115-6A-0002; CCS #1

Page	Citation
3-52	Bourgoyne, A.T. Jr., Scott, S.L., Regg, J.B., 1999, "Sustained Casing Pressure in Offshore Producing Wells",OTC (SPE) Paper 11029
3-52	Goodwin, K.J., and Crook, R.J., 1992, "Cement Sheath Stress Failure", SPE Paper 20453
3-52	Sabins, F., 2004, "MMS Project: Long-Term Integrity of Deepwater Cement Systems Under Stress/Compaction Conditions, Summary Report,"
3-52	Teodoriu, C., Reinicke, K.M., Fitcher, C., Wehling, P., 2010, "Investigations on casing-cement interaction with applications to gas and CO2 storage wells," SPE Paper 131336